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Brown Root Rot of Alfalfa

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Brown root rot (BRR) was first detected in an alfalfa field near Farson (Sweetwater County) in western Wyoming during the spring of 1996. It was associated with severe winterkill of alfalfa plants. Many surviving plants were severely stunted and slow to green-up. Roots of affected plants showed varying degrees of rot. Prior to this discovery, BRR had only been reported from Alaska in the United States, but it has been known for many years to cause stand and yield losses in alfalfa and other legumes in Canada. The presence of BRR in established stands of alfalfa may result in shortened stand life and reduced hay yield.

Figure 1. Three-year-old alfalfa plant collected near Farson showing severe rot of the tap and secondary roots caused by brown root rot. Note the dark brown to black discoloration of the lower plant crown and upper root.

Symptoms. Although BRR may be detected on 2-year-old plants, distinguishable root symptoms are usually not present until the third year after seeding. Root symptoms consist of tap and secondary root rot (Figure 1). Feeder roots and nitrogen fixing nodules are often the first tissues to show discoloration and rot. Symptoms vary from small circular dark lesions to larger areas with rot which may completely severe the root from the plant (Figure 2). Crowns and shoots of affected plants may either be partially or entirely killed. Fruiting structures of the fungus, *Phoma sclerotioides*, may be present as tiny black dots on the surface of diseased roots. Some plants with BRR may remain productive over the short-term while others exhibit varying degrees of above-ground stunting and decline. Winterkill, a symptom of BRR that is generally noticed in the early spring, may vary from slight (< 5% dead plants) to severe (> 95% dead plants).

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Figure 2. Three-year-old plants affected by brown root rot. The plant on the right is dead with the tap root completely rotted, while the plant on the left has a dark brown girdling lesion on the root and was slow to produce spring growth. Plants were collected near Farson.

Diseased plants often green-up slowly in the spring (Figure 3). BRR appears to occur throughout fields rather than in localized areas. In an established alfalfa field near Eden, Wyoming an estimated 88% of plants sampled throughout the field had BRR symptoms.

Distribution. BRR was first identified in an alfalfa field near Farson in Sweetwater County at 6,580 feet in elevation. Since this disease has previously been associated with cold, northern climates, fields in six counties were surveyed in high elevation alfalfa growing areas. BRR was detected in Albany, Carbon, Lincoln, Sublette, Sweetwater, and Uinta counties (Figure 4). All of these alfalfa production areas range from 6,135 to 7,600 feet in elevation. The disease was most severe in the upper Green River Valley and appears to be the only major stand decline disease in this region. So far, BRR is estimated to be present in over 35,500 acres of irrigated alfalfa in the six counties surveyed. BRR has also been identified from diseased alfalfa plants from one certified seed field near Powell in Park County at 4,365 ft. in elevation and from one hay field near Worland in Washakie County at 4,365 ft. in elevation, and therefore may be present throughout the Big Horn Basin. BRR has also been reported from one field in Montana in 1996 and from two fields in Idaho near the Wyoming border during the Lincoln County survey in 2001. In the spring of 2003, BRR was confirmed in several fields in Wisconsin having severe winterkill. This finding suggests BRR may have a much larger area of occurrence in the northern alfalfa production areas than previously thought.

Figure 3. Winterkill of alfalfa near Farson in 1996 due to severe brown root rot injury.

Similarity to other diseases. Phytophthora root rot (PRR) is the only other root disease of alfalfa in Wyoming that could be confused with BRR. Although PRR was not detected in Lincoln, Sublette, Sweetwater, or Uinta counties during the field surveys, it was found in Albany and Carbon counties. Positive diagnosis of BRR usually requires microscopic observation and fungal isolation from diseased tissue. Familiarity with symptoms of both diseases will help in separating these two important root diseases. First, while PRR affects seedlings, as well as, older plants, BRR appears not to attack plants until they are 1- to 2-years-old and doesn't produce recognizable symptoms until plants are 2-years-old and older. Secondly, while affected root tissue of BRR-diseased plants is usually dark brown to black, root tissue of PRR-diseased plants is usually reddish brown. Also, outer root tissue of BRR-diseased plants sloughs off exposing the dark cortex, while the outer root tissue layer of PRR-diseased plants usually remains intact. And lastly,

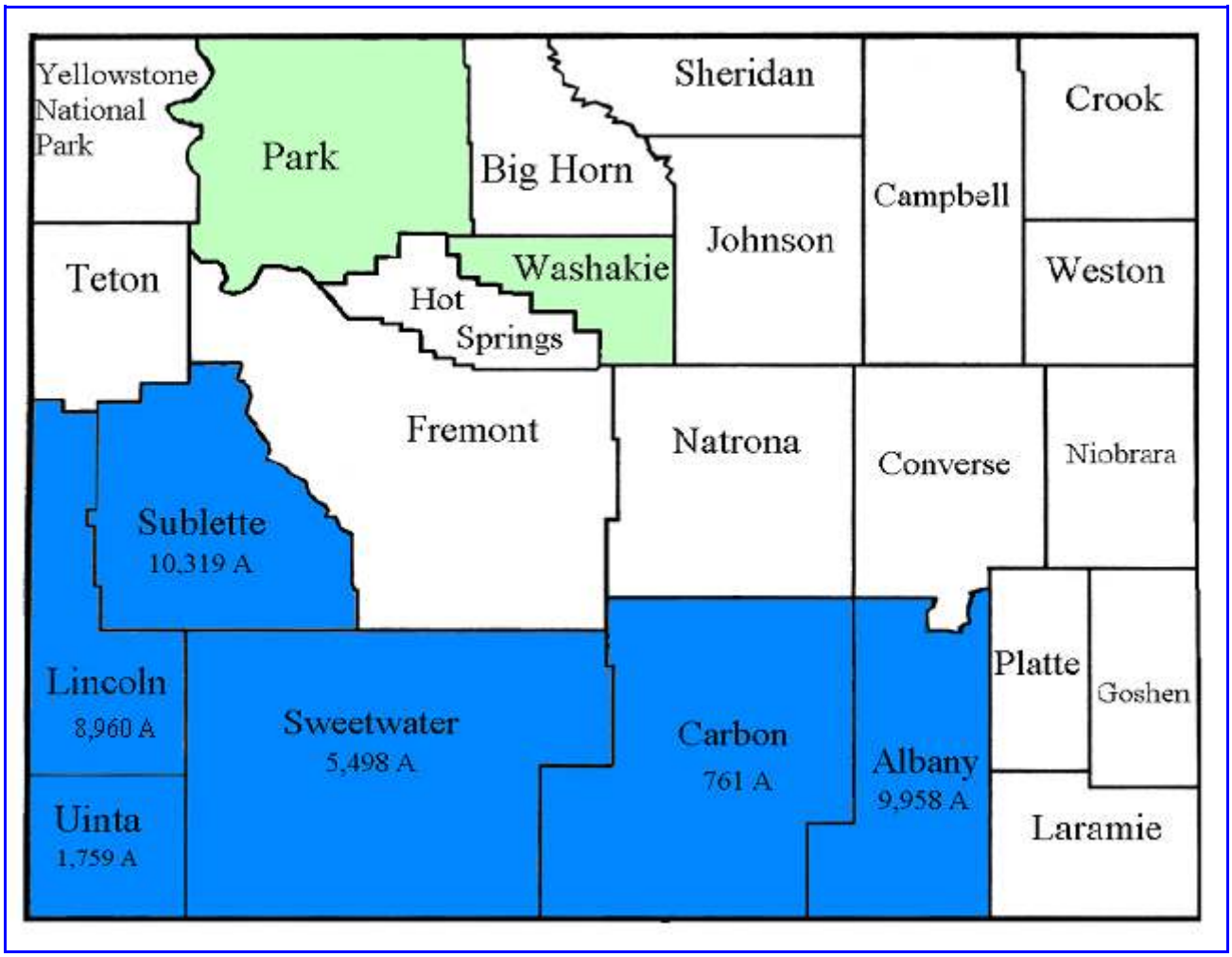

Figure 4. Distribution of brown root rot of alfalfa in Wyoming. ■ *= counties where extensive surveys have been conducted. Area infested with BRR is given for each county.* ■ *= counties where one or more fields were found to have BRR but an extensive survey has not been made.* □ *= counties where surveys have not been conducted.*

while plants affected with BRR may have small black reproductive fungal structures attached to outer root tissue, PRR diseased plants do not. However, both can cause winterkill of plants.Winterkill may also be caused by the alfalfa stem nematode (ASN). This stem bud parasite causes stunting and swelling of stem buds thus reducing sugar production and carbohydrate storage in upper tap roots in the fall. However, ASN does not cause root rot. The ASN is a major stand decline disease in Albany and Carbon Counties, and is a major alfalfa disease in the Wind and Big Horn River Basins.

Disease Cycle. Research conducted in Canada indicates *P. sclerotioides* may occur on plants native to North America. Many legume plant species including alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*), sweet clover (*Melilotus* spp.), alsike clover (*Trifolium hybridum*), sainfoin (*Onobrychis viciifolia*), and bird's-foot trefoil (*Lotus corniculatus*) are known to be parasitized by the fungus. It is considered to be highly pathogenic on sainfoin and sweetclover. Recent plant-tissue isolations from diseased cicer milkvetch (*Astragalus cicer*) plants from a field near Farson, Wyoming, exhibiting winterkill indicated the fungus was present. *P. sclerotioides* may also live saprophytically on dead roots of many plant species, including small grain crops.

P. sclerotioides can survive for several years in dry soil with small dormant fungal structures

called pycnosclerotia. These structures may be responsible for its spread via soil and plant debris. In the presence of a host plant root, pycnosclerotia apparently germinate under favorable environmental conditions and infect roots. Later, after the fungus colonizes the root, black fruiting structures (pycnidia) are formed on and in root tissue. When mature, these structures produce spores (conidia). Observations by the authors indicate spores from pycnidia on dead stems may play a role in secondary, above ground infection of healthy plants. Upper crown and lower stem areas of diseased plants may also be infected. Root infection appears to occur during the spring when plants emerge from their winter dormant state. Prolonged periods of snow cover during this time provide an extended period of favorable environmental conditions for infection. Optimum mycelial growth and sporulation of the fungus occurs at 60°F while minimum and maximum temperatures are 32°F and 81°F. However, host root infection most likely occurs between 35° and 40°F.

Control. The following management practices, recommended by Canadian researchers for use in that country, are suggested to reduce alfalfa yield loss from BRR in Wyoming. Additionally, alfalfa variety selection from stands that have exhibited long-term persistence in the Farson area may provide additional disease control.

Crop rotation. A rotation including three years with spring-sown annual crops such as barley, wheat, oats, or hay millet between alfalfa crops is recommended. These non-host crops should reduce the soil population of *P. sclerotioides.* Alfalfa should not be planted following other susceptible legumes since this may worsen the disease on alfalfa.

Host resistance and variety selection. Developed for Alberta, Canada, 'Peace' is the least susceptible alfalfa variety tested for BRR in Canadian tests. U.S. seed companies have not developed BRR resistant alfalfa varieties since the disease was previously not known to be present in the lower 48 states. Peace is extremely winter dormant and may be susceptible to other stand decline diseases, including Verticillium wilt, Phytophthora root rot and the alfalfa stem nematode, which are present in most Wyoming alfalfa growing areas. Although use of this variety throughout Wyoming is not recommended, it appears to be well adapted to the Farson area where these above-mentioned diseases have not been found.

Forage yield data collected from an alfalfa variety test in Eden, Wyoming, where BRR is present, may indicate some level of resistance in several U.S. varieties. Yields collected seven years following seeding of a forage evaluation trial conducted by Dr. Alan Gray indicate the U.S. varieties Ranger, Webfoot MPR and Alpine, fall dormancy (FD) ratings of 3, 4 and 2, respectively, persisted well in the presence of BRR while the varieties OK-49, Multi-plier and Polyleaf (FD ratings of 5, 3 and 3, respectively) showed severe stand decline. Although Ranger performed very well in Eden, it may not perform as well in parts of Wyoming where other stand decline diseases are present. Several Canadian entries, including Heinrichs (FD rating of 1), also performed very well. Studies in the Farson area have resulted in additional information on the adaptability and yield of varieties grown in the presence of BRR. After three years of data collection (5 cuts) at the Kim Brown site, Ranger, Peace and Anik (yellow flowered alfalfa variety from Canada) have maintained the best stands and yield with Ranger and Peace having the highest yields. After four years of data collection (6 cuts) at another test located on the Don Miller farm, the same three varieties (Range, Peace and Anik) have the best stands. However, the highest yielding varieties are Spreador 3, Multi-plier, Winterstar and Avalanche + Z. For assistance in selecting an adapted alfalfa variety with multiple disease resistance, refer to the "on-line" Bulletin B-1136, "Alfalfa Disease Management."

An experimental BRR-resistant variety has been developed from surviving plants in the 7-year-old variety trial at Eden. Evaluation of this variety is now underway.

Cultural management. Additional recommendations from Canada are: (1) avoid excessive cutting, (2) avoid cutting between mid-August and late fall, (3) avoid grazing in the fall before the ground is frozen, (4) do not overgraze, and (5) maintain optimum soil fertility.

Wyoming alfalfa stands should not be cut more than is recommended for a given production area (two cuts for Sweetwater County). Alfalfa hay should be cut allowing sufficient regrowth (6 - 8 inches) to supply carbohydrates in the upper root and crown prior to the first hard freeze (28°F or below). Only graze fields in the fall after plants are frosted-down and after the ground is frozen.

Summary. Brown root rot appears to be widespread in high elevation growing areas of Wyoming with an estimated 35,500 acres currently infested. This estimate will likely climb following additional surveys. Severe winterkill in 1995-1996 (50% loss) and again in 1998-1999 (80% loss) in the Farson area is attributed, in part, to BRR. While severe winterkill is not expected to occur every year, it will undoubtedly occur again when winter conditions are favorable for BRR. Limited winterkill with forage yield loss from stunted, diseased plants is expected to occur yearly. Integration of a 3-year crop rotation with a spring-sown small grain, good harvest management practices, and growing an alfalfa variety which is known to have long-term persistence in your area should help to reduce loss from this disease in Wyoming. The Wyoming experimental BRR-resistant variety will hopefully be available soon for Wyoming growers. The recent discovery of BRR associated with winterkill of alfalfa plants in Wisconsin has created interest in several alfalfa seed companies and hopefully will result in the future development and release of BRR resistant varieties for U.S. growers.

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NOTE: This publication is available on-line at http://www.uwyo.edu/plants/publications/RootRot1.htm.